

REMARKS

Claims 1-21 are pending in this application. Claims 1, 11 and 21 have been amended, and claims 10 and 20 have been canceled by the present Amendment. Amended claims 1, 11 and 21 do not introduce any new subject matter.

The present invention relates to a system and method for optical measurement of planarized features. According to an embodiment of the invention, analysis of the optical characteristics of a reflected light beam can be maximized based upon a reduction in complexity of the planarized features due to a similarity in refractive indexes corresponding to a bulk silicon substrate and a poly silicon fill of the semiconductor device.

According to an embodiment of the present invention, analysis of the optical characteristics of a reflected light beam can be maximized based upon a simplified geometry of the planarized features with respect to a geometry of similar, un-planarized features.

ALLOWABLE SUBJECT MATTER

The Examiner objects to claims 10 and 20 as being dependent upon a rejected base claim, and indicates that claims 10 and 20 would be allowable if rewritten in independent form including all of the limitations of the base and any intervening claims.

Applicants note the Examiner's indication of allowable subject matter in claims 10 and 20.

At this point, Applicants note an apparent inconsistency in the Office Action. At page 5 of the Office Action, the Examiner maintains that the following element of claim 21 is disclosed in Fig. 17 of U.S. Patent No. 6,545,753 ("Subramanian"): "maximizing

the analysis of the optical characteristics based upon a reduction in complexity of the planarized features due to a similarity in refractive indexes corresponding to a bulk silicon substrate and a poly silicon fill of the semiconductor device". The subject matter of this claim element is the same subject matter that the Examiner has deemed allowable with respect to claims 10 and 20.

Applicants respectfully submit that the Examiner is correct in concluding that the subject matter of claims 10 and 20 is allowable and that the Examiner is mistaken in his conclusion that Subramanian anticipates the same subject matter recited in claim 21. Indeed, Applicants respectfully submit that Subramanian does not disclose or suggest maximizing the analysis of the optical characteristics of a reflected light beam based upon reduced complexity of the planarized features due to a similarity in refractive indexes of a bulk silicon substrate and a poly silicon fill, as recited in original claims 10, 20 and 21.

Subramanian relates to a system and method for monitoring and regulating dual damascene processing of a semiconductor substrate, wherein light reflected from a wafer is collected and processed. However, Subramanian contains no disclosure connecting reduced complexity of planarized features with similarity between refractive indexes of a bulk silicon substrate and a poly silicon fill. Indeed, Subramanian makes no mention at all of refractive indexes of a bulk silicon substrate and a poly silicon fill or of a comparison between the two.

Subramanian only generally states a known concept in the art, that light is reflected and/or refracted differently from surfaces having different indexes of refraction. See col. 17, line 64 to col. 18, line 8. Further, neither Fig. 17 nor the portions of the disclosure explaining Fig. 17 contain any reference to index of refraction.

Therefore, because Subramanian contains no teaching regarding maximizing the analysis of the optical characteristics of a reflected light beam due to a similarity in refractive indexes of a bulk silicon substrate and a poly silicon fill, Applicants respectfully submit that the Examiner correctly allowed the subject matter of claims 10 and 20 and erroneously rejected claim 21.

CLAIM OBJECTIONS

Reconsideration is respectfully requested of the Examiner's objection to claims 10 and 20 as being dependent upon a rejected base claim. In response to the Examiner's objection, Applicants have canceled claims 10 and 20 and rewritten claims 10 and 20 in independent form by incorporating claims 10 and 20 into claims 1 and 11, respectively.¹

Therefore, Applicants respectfully submit that, in light of the amendments made to independent claims 1 and 11, claims 10 and 20 are no longer dependent upon rejected base claims. Accordingly, Applicants respectfully request that the Examiner withdraw his objection to same.

REJECTIONS UNDER 35 U.S.C. § 102(e)

Reconsideration is respectfully requested of the rejection of claims 1-3, 5, 6, 9, 11-13, 15-16, 19 and 21 under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,545,753 ("Subramanian").

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." Verdegaal Bros. v. Union Oil Co. of California, 814 F.2d 628, 631, 2 U.S.P.Q.2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as

is contained in the . . . claim." Richardson v. Suzuki Motor Co., 868 F.2d 1226, 1236, 9 U.S.P.Q.2d 1913, 1920 (Fed. Cir. 1989); M.P.E.P. § 2131.

Applicants respectfully submit that claims 1-3, 5, 6, 9, 11-13, 15-16, 19 and 21 as amended are not anticipated by Subramanian.

With respect to independent claims 1 and 11, and all claims dependent thereon, Applicants have incorporated the allowable subject matter of claims 10 and 20 into claims 1 and 11, respectively. As argued above, although the Office Action includes an apparent inconsistency, the subject matter is indeed allowable over the cited references. Therefore, Applicants respectfully submit that claims 1 and 11, as amended, are not anticipated by Subramanian.

Claims 2-3, 5, 6 and 9 depend from claim 1, and claims 12-13, 15-16 and 19 depend from claim 11. Therefore, for at least the reason of their dependent status, claims 2-3, 5, 6, 9, 12-13, 15-16 and 19 are also submitted not to be anticipated by Subramanian.

With respect to claim 21, the Examiner has rejected claim 21, stating that Subramanian, at col. 2, line 51 to col. 3, line 15, discloses "maximizing an analysis of the optical characteristics based upon a simplified geometry of the planarized features with respect to a geometry of similar, un-planarized features". Applicants respectfully submit that this feature is neither disclosed nor suggested by the cited reference.

Subramanian discloses comparing etch results to desired results to control the endpoint of an etch process. However, Subramanian contains no teaching regarding the geometry of planarized features compared to the geometry of similar, un-planarized features. Accordingly, Applicants respectfully submit that claim 21, as amended, is not

¹ Claims 10 and 20 depended from claims 1 and 11, respectively.

anticipated by Subramanian.

Therefore, Applicants respectfully request that the Examiner withdraw his rejection of claims 1-3, 5, 6, 9, 11-13, 15-16, 19 and 21 under 35 U.S.C. § 102(e).

REJECTIONS UNDER 35 U.S.C. § 103(a)

Reconsideration is respectfully requested of the rejection of claims 4, 7, 8, 14, 17 and 18 under 35 U.S.C. § 103(a) as being unpatentable over Subramanian in view of U.S. Patent No. 6,307,627 ("Vurens"). Applicants respectfully submit that the amendments made to independent claims 1 and 11 render claims 4, 7, 8, 14, 17 and 18 patentable over the cited references.

As argued above, Applicants have incorporated the allowable subject matter of claims 10 and 20 into independent claims 1 and 11, and all claims dependent thereon. Therefore, Applicants respectfully submit that claims 1 and 11, as amended, are patentable over Subramanian in view of Vurens.

Claims 4, 7 and 8 depend from claim 1, and claims 14, 17 and 18 depend from claim 11. Therefore, for at least the reason of their dependent status, claims 4, 7, 8, 14, 17 and 18 are also submitted to be patentable over Subramanian in view of Vurens.

As such, Applicants request that the Examiner withdraw his rejection of claims 4, 7, 8, 14, 17 and 18 under 35 U.S.C. §103(a).

An early and favorable reconsideration is earnestly solicited. If the Examiner has any further questions or comments, it is suggested that he telephone Applicants' Attorney to reach a prompt disposition of this application.

Respectfully submitted,

A handwritten signature in cursive script, reading "Michael F. Morano", written in dark ink.

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Please amend the subject application as follows:

IN THE CLAIMS:

Please cancel claims 10 and 20 and accept amended claims 1, 11 and 21 as follows:

1. (currently amended) A method for measuring planarized features on a wafer of a semiconductor device, comprising the steps of:

illuminating the planarized features on the wafer;

detecting a reflected light beam with respect to the planarized features; and

analyzing optical characteristics of the reflected light beam to determine information corresponding to the planarized features, wherein said analyzing step maximizes an analysis of the optical characteristics based upon a reduction in complexity of the planarized features due to a similarity in refractive indexes corresponding to a bulk silicon substrate and a poly silicon fill of the semiconductor device.

2. (original) The method of claim 1, wherein the information comprises sizes of the planarized features.

3. (original) The method of claim 1, wherein the information comprises grating compositions of the planarized features.

4. (original) The method of claim 1, wherein said detecting step is performed

using an ellipsometric technique.

5. (original) The method of claim 1, wherein said detecting step is performed using a scatterometric technique.

6. (original) The method of claim 1, wherein said detecting step is performed using a reflectometric technique.

7. (original) The method of claim 1, wherein said detecting step is performed using a polarimetric technique.

8. (original) The method of claim 1, wherein said detecting step is performed using at least one of an ellipsometric, a scatterometric, a reflectometric, and a polarimetric technique.

9. (original) The method of claim 1, wherein said analyzing step maximizes an analysis of the optical characteristics based upon a simplified geometry of the planarized features with respect to a geometry of similar, un-planarized features.

10. (canceled)

11. (currently amended) A system for measuring planarized features on a wafer of a semiconductor device, comprising:

an illumination tool for illuminating the planarized features on the wafer;

a detection tool for detecting a reflected light beam with respect to the planarized features; and

an analysis tool for analyzing optical characteristics of the reflected light beam to determine information corresponding to the planarized features, wherein said analysis tool maximizes an analysis of the optical characteristics based upon a reduction in complexity of the planarized features due to a similarity in refractive indexes corresponding to a bulk silicon substrate and a poly silicon fill of the semiconductor device.

12. (original) The system of claim 11, wherein the information comprises sizes of the planarized features.

13. (original) The system of claim 11, wherein the information comprises grating compositions of the planarized features.

14. (original) The system of claim 11, wherein said detection tool employs an ellipsometric technique to detect the reflected light.

15. (original) The system of claim 11, wherein said detection tool employs a scatterometric technique to detect the reflected light.

16. (original) The system of claim 11, wherein said detection tool employs a reflectometric technique to detect the reflected light.

17. (original) The system of claim 11, wherein said detection tool employs a polarimetric technique to detect the reflected light.

18. (original) The system of claim 11, wherein said detection tool employs at least one of an ellipsometric, a scatterometric, a reflectometric, and a polarimetric technique to detect the reflected light.

19. (original) The system of claim 11, wherein said analysis tool maximizes an analysis of the optical characteristics based upon a simplified geometry of the planarized features with respect to a geometry of similar, un-planarized features.

20. (canceled)

21. (currently amended) A method for measuring planarized features on a wafer of a semiconductor device, comprising the steps of:

illuminating the planarized features on the wafer;

detecting a reflected light beam with respect to the planarized features; and

analyzing optical characteristics of the reflected light beam to determine information corresponding to the planarized features, wherein said analyzing step comprises the ~~steps~~ step of:

maximizing an analysis of the optical characteristics based upon a simplified geometry of the planarized features with respect to a geometry of similar, un-planarized features; and

~~maximizing the analysis of the optical characteristics based upon a~~

~~reduction in complexity of the planarized features due to a similarity in refractive indexes corresponding to a bulk silicon substrate and a poly silicon fill of the semiconductor device.~~